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ABSTRACT

This paper presents a model of adult reasoning that is consistent with a set of related psychological theories of learning known collectively as constructivism. Three general factors comprise the model: (1) personal epistemology (defined as beliefs about learning, dispositions toward thinking, and assumptions about knowledge itself); (2) sustained contextual support (defined in terms of practice coping with ill-structured problems); and (3) immediate contextual support (defined in terms of the level of scaffolding provided in a problem solving situation). Although the model has broad applicability for thinking about adult intellectual development, the focus of this paper is on the reflective thinking capabilities of young adults preparing to become teachers. Literature leading to the identification of factors in the model is highlighted, research generated by the model is reviewed, and implications of the model for teacher education are discussed. (Contains 62 references.)
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Constructivism, Personal Epistemology, and Teacher Education:
Toward a Social-developmental Model of Adult Reasoning

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Running head: Social-developmental model of adult reasoning

ABSTRACT

I present a model of adult reasoning that is consistent with a set of related psychological theories of learning known collectively as constructivism. Three general factors comprise the model: (1) personal epistemology (defined as beliefs about learning, dispositions toward thinking, and assumptions about knowledge itself); (2) sustained contextual support (defined in terms of practice coping with ill-structured problems); and (3) immediate contextual support (defined in terms of the level of scaffolding provided in a problem solving situation). Although the model has broad applicability for thinking about adult intellectual development, the focus of this paper is on the reflective thinking capabilities of young adults preparing to become teachers. Literature leading to the identification of factors in the model is highlighted, research generated by the model is reviewed, and implications of the model for teacher education are discussed.

**Constructivism, personal epistemology, and teacher education:
Toward a social-developmental model of adult reasoning**

*The first goal of a teacher is to know thyself;
the second goal is to know thy students.*

Attributed to Socrates (paraphrased)

Many educational problems derive from a lack of attention on the part of educators to ways of knowing. In particular, the lack of a clear conception about the epistemologies operating within classrooms, schools, and disciplines often leads to an overemphasis on acquiring content knowledge at the expense of inculcating mature intellectual habits and dispositions. In this vein, Greeno (1989) argued that in spite of advances in the psychology of human cognition, there has been little perceptible progress toward a coherent theory of higher order thinking. He suggested the adoption of three framing assumptions in the quest for such a theory: (1) thinking is situated in physical and social contexts; (2) thinking and learning are influenced by beliefs about the nature of knowledge and learning (personal epistemologies); and (3) people enter learning situations with conceptual competencies that enable complex thinking and knowledge construction to take place. These framing assumptions are similar to a constructivist psychological perspective being hailed by some as the appropriate core component of teacher education. Thus, the relationship between constructivism, higher order thinking, and the preparation of teachers seems to be an intimate one.

If one of the goals of teacher education is to help pre-service teachers develop skills and dispositions in higher order thinking within a constructivist perspective, then it behooves teacher educators to model behavior -- conduct research and teach -- in ways that are consonant with knowledge about adult ways of knowing. The purpose of this paper is to describe a social-developmental model of higher order thinking that integrates Greeno's assumptions in a systematic and purposeful manner. In designing the model, several criterion were considered essential. First, the model must be consistent with a constructivist psychological perspective. Second, it must incorporate what we know about adult reasoning -- namely conceptions of adult problems and theories of post-formal intellectual development. Third, the model must serve as a heuristic for research and teaching in higher education. The formal model is presented following a brief description of the context in which it was constructed.

Background and purpose

A team of educational psychologists recently articulated the tenets of a "contemporary psychological perspective" as a guide to assist in the preparation of prospective teachers (Anderson, Blumenfeld & Pintrich, Clark, Marx, & Peterson, in press). At the core of this

perspective is "an image of learners as active and social constructors of meaning, and learning as an act of construction through social interaction in many contexts" (pg. 8). Specific principles of constructivist theory include the following: (1) people learn from new experiences (i.e. they construct personal meaning) on the basis of prior knowledge; (2) new knowledge is always situated; that is, it is "inextricably linked to the situations in which it has been acquired and used" (pg. 4); and (3) learning is socially mediated and acquired within learning communities. So powerful are the implications of these principles, Anderson and her colleagues advocated the development of a contemporary psychological perspective as the main goal of an educational psychology class.

In fact, this new perspective is already influencing the preparation of teachers. For example, one leading school of education (California at Berkeley) has spent over a decade in the design, direction, and implementation of a "developmental-constructivist approach to teacher education" (Black & Ammon, 1992, pg. 323ff). The goals of the program are twofold. First, faculty hope to imbue education students with an understanding of constructivism and how this knowledge will affect their teaching. For instance, elementary education majors are taught to recognize levels of *child development* as conceptual hurdles, making it possible for them to devise curricula that address childrens' learning difficulties. The second goal of the program has been to construct a model of *teacher development* that education faculty can use to devise means for helping university students overcome conceptual hurdles in learning to teach. The model captures epistemological changes in individuals' pedagogical thinking as it develops over the entire course of the program.

Although the emphasis on constructivist ideas adds a unique dimension to teacher education, the first goal of preparing pre-service teachers to deal with youngsters at varying levels of development has been a common focus of teacher training programs for years. However, the second goal of identifying *specific* developmental patterns of pre-service teachers themselves represents a departure from the traditional model of teacher education. Although public descriptions of the Berkeley program do not acknowledge it explicitly, this goal is consistent with a growing body of theory and research showing the importance of *general* epistemological development among young adults. Given the importance of developing a constructivist psychological perspective, it seems that any teacher education program could not function adequately without knowledge of their students' personal epistemologies, including the nature of adult conceptual orientations as well as the complexities and nuances of adult reasoning. Unfortunately, schools of education have been doing just that for decades -- training pre-service teachers without adequate attention to the origin, development, and influence of their epistemological beliefs.

A social-developmental model of higher order thinking

Models are typically simplified representations of complex phenomena, and Figure 1 is no exception. It represents a parsimonious way to conceptualize interdependent factors that influence higher order thinking. It also serves as a blueprint for designing empirical studies, instructional interventions, and assessment alternatives that promote reasoning among young adults. The main function of the social-developmental model is to facilitate the formation and testing of hypotheses in response to the following question: How does personal epistemology interact with social-contextual factors to influence reasoning performance when pre-service teachers are confronted with authentic problems in teaching? If the model is to be used as a vehicle for generating predictions to such a question, it must allow for the specification of the following components: [1] the nature and sophistication of adult conceptual orientations (epistemic development); [2] the nature of students' social learning history, including practice at dealing with problems in the domain (sustained contextual support); and [3] the nature of performance situation characteristics, including the level of assistance provided when solving specific tasks in the domain (immediate contextual support). Finally, the model must account for the dynamic interaction and interdependence of these variables across multiple situations.

[Insert Figure 1 about here]

The first component in Figure 1, *epistemic development*, is defined in terms of learners' beliefs about knowledge and dispositions toward learning. The assumption underlying this variable is that teachers face an assortment of complex problems and, to exhibit effective reasoning in situations where simple solutions do not exist, they must possess a sufficiently mature set of epistemological beliefs and dispositions. The assumption underlying the second component, *sustained contextual support*, is that exposure to uncertainty, practice with complex problems, and immersion or guided instruction in mature ways of approaching problems has the potential to mediate epistemic deficiencies. Although epistemic development and sustained contextual support are continuous variables, they are shown in Figure as three distinct rows and columns. By representing variables in a matrix, a final component, *immediate contextual support*, can be added to the model. The assumption underlying this variable is that epistemic development and prior experience interact with factors situated in the immediate environment in which reasoning is assessed.

To create a scheme for thinking about assessment situations, performance tasks are shown in Figure 1 as capital letters, each corresponding to a different response mode predicted to provide a relative amount of immediate contextual support. "R" refers to *recognition tasks* (e.g. students are asked to rank prototypic responses to ill-structured problems from least to most

reasonable). An *explanation task*, labeled "E" in the matrix, is thought to be less supportive than a recognition task. (For example, students are asked to articulate the reasons for their choices in sorting statements on a recognition task.) Finally, "P" refers to *production tasks* (e.g. students are asked to generate their own responses to ill-structured reasoning problems). Production tasks are hypothesized to be progressively less supportive than the previous tasks since generating a mature response is cognitively more demanding than either recognizing or explaining one (see Rest, 1973 and Lynch, 1989).

To read the matrix, capital letter entries indicate cases in which evidence of relatively adequate reasoning is predicted to occur within the context of a particular response mode. An ellipsis (...) indicates that hypothetical levels of development and prior experience are not sufficient for students to respond effectively in a given mode, whereas a question mark (?) implies that the ability of an individual to perform effectively on a particular task is theoretically indeterminate.¹ A few examples will clarify the logic of the matrix depicted in Figure 1.

In the lowermost left cell, individuals at a naive level of epistemic development might accurately judge (Recognize) a product of someone's thinking as more or less reasonable, even though those individuals have had little or no prior experience in making such distinctions. However, their ability to abstract a reasoning principle (that is, to "Explain" the reason for their judgments), as well as their ability to "Produce" an epistemologically mature essay on their own, will lag behind their ability to sort protocols according to certain epistemic criteria. In both the uppermost left cell and the lowermost right cell, an individual is still expected to make accurate judgments about (i.e. Recognize) statements on the basis of reasonable epistemic principles. In addition, the student is now able to articulate (i.e. Explain) a meaningful principle which serves as the criterion for such differences, either because the student's level of epistemic development is sufficiently mature or because the nature and amount of her prior experience has been adequate to perform the task. In either case, however, it is still uncertain whether the student will be able to generate (P) products that reflect those same principles of mature reasoning in their own writing or conversation.

Finally, one would expect an effective response to all three types of tasks only when the combination of epistemic maturity and prior experience reaches a sufficient level. This is shown in the upper right cells of the matrix, indicating that students are able to recognize (R), explain (E), and produce (P) responses that reflect higher order thinking. As it applies to teacher education, the theoretical assumption underlying the social-developmental model shown in Figure 1 can be summarized in the following way: The ability of pre-service teachers to exhibit higher order thinking about inherently ill-structured problems is a function of several interdependent factors, including general epistemic orientation, the nature and amount of prior

experience in dealing with such problems, and the level of scaffolding provided in a performance situation.

In the next section, an abridged review of literature supporting each of these factors is presented. This review is by no means exhaustive. It is offered to provide examples of the types of resources teachers might employ to make the general components of the social-developmental model more relevant to their specific context.

Personal epistemology

Ill-structured problems

A primary responsibility of any teacher is to consider the types of problems students will face in a particular domain. Problems and issues are sometimes categorized according to the degree of certainty with which they can be resolved. Well-structured problems are characterized by a high degree of simplicity and the possibility of a single, correct answer. Ill-structured problems are characterized by complexity and uncertainty resulting from incomplete information, antithetical arguments, nuanced judgments, and the possibility of multiple solutions (Wood 1983; Kitchener, 1983). This distinction is especially critical in teacher education. Although the transition from adolescence to adulthood is accompanied by, if not fueled by, an increasing number of inherently uncertain situations for most young people, the complexities and ambiguities with teaching are especially pronounced (Anderson et al., in press). Given the uncertainties associated with teaching, a consideration of the nature of ill-structured problems is therefore essential. In turn, understanding the way young teachers make decisions in the face of uncertainty requires consideration of several important factors; these factors comprise the components of the social-developmental model.

Epistemic development

Specific epistemic processes. Presseisen (1986) defines epistemic processes as "the kinds of thinking related to particular bodies of knowledge or subject matters and the particular problems addressed by these knowledge areas as well as the interdisciplinary relationships among content areas" (pg. 9). For content area teachers, the literature is rife with discussions about various conceptions and misconceptions young people typically bring to school. Since the main purpose of this paper is to use the social-developmental model in the context of teacher education, an exhaustive review of this literature would be out of place. However, such discussions do serve to show how teachers can facilitate their decision-making by inserting domain-specific considerations of students' conceptual orientations into the category labeled "epistemic development" in Figure 1.

In designing instruction and assessment, for example, teachers should consult constructivist research that has been devoted to the nature of student beliefs and conceptual orientations in math (Schoenfeld, 1991; Cobb, 1994), science (Carey, 1986; Roth, 1993; Driver et al., 1994), physics (Hammer, 1994), social studies (Newmann, 1991), and history (Wineburg, 1991a; 1991b). An interesting question with regard to much of this literature is the extent to which beliefs are linked to a particular community of discourse or whether they represent pervasive intellectual dispositions that might be characterized as part of a general epistemology toward learning and knowledge itself. For example, Hammer distinguished between specific conceptions about principles in physics -- such as *heavier things fall faster* -- and more general epistemological beliefs -- such as *learning physics means receiving information* or *learning physics involves an active process of reconstructing one's understanding*. In this case, the former beliefs are specific to the content of physics, whereas the latter beliefs might affect student learning in multiple domains. Similarly, Schoenfeld's (1983) discovery of a common high school belief that *math problems not solved within 5 minutes can't be solved at all* might be part of a more pervasive mindset, characterized by the belief that *learning (in general) occurs quickly or not at all* (Schommer, 1989). Finally, Wineburg (1991b) found that novice high school students were more likely than expert historians to rate textbooks over primary source documents as the most reliable source of historical information. Again, this may be part of a self-fulfilling, lower-order mindset of principles (e.g. "knowledge is created primarily by authorities, not within oneself") that is developed over years of formal schooling and generalizes to domains other than history (Newmann, 1991, pg. 393).

Given the corpus of evidence on the role and importance of domain-specific knowledge in learning, it would be foolish to suggest that personal epistemologies exist independent of specific communities of discourse (Brophy, 1992). Even in the area of teacher education, experts have described aspects of pedagogic content knowledge (Shulman, 1986) as well as teachers' conceptions of teaching and learning (Black & Ammon, 1992). And, while it is possible to speculate about naive beliefs in areas such as educational psychology (e.g. extrinsic rewards always have a positive effect on learning), the specific impact of teacher education courses on the development of such beliefs has not been studied extensively. That is not to say that college educators do not have valuable resources for designing instruction and assessment aimed at conceptual change among pre-service teachers. In particular, there is evidence that many beliefs coalesce to form generalizable mindsets, or dispositions, that may serve as obstacles to learning in any field. Some of this evidence is described next.

General epistemic processes. Researchers and theorists interested in the intellectual maturity of college students have concluded that traditional conceptions of critical thinking and cognitive development do not capture a larger set of reasoning abilities necessary for making

decisions in the face of inherently ill-structured conditions. For example, Resnick (1987) catalogued key features of higher order thinking, suggesting that it is non-algorithmic, complex, and often yields multiple solutions; it also involves uncertainty, nuanced judgment, the application of multiple criteria and the construction of meaning. Similarly, Facione and colleagues (Facione, Sanchez, & Facione, 1994) have designed an instrument for evaluating seven critical thinking dispositions. Among these is an intellectual maturity subscale, described by the authors in this way (pg. 7):

The ... mature person can be characterized as one who approaches problems, inquiry, and decision making with a sense that some problems are necessarily ill-structured, some situations admit of more than one plausible option, and many times judgments must be made based on standards, contexts and evidence which preclude certainty.

This definition of intellectual maturity is similar to what King and Kitchener (1994) refer to as reflective judgment (after Dewey, 1933). This aspect of higher order thinking is based on the notion of epistemic cognition, defined by Kitchener (1983) as the processes one invokes to monitor the epistemic nature of problems and to determine the truth value of alternative solutions. Developmental psychologists have argued that successful resolution of ill-structured problems is dependent on a set of beliefs and dispositions that are characterized by the highest stages of epistemic cognition, alternatively referred to as post-formal operations (Commons et al., 1990), dialectical reasoning (Basseches, 1989), or reflective judgment. Collectively, these aspects of mature problem solving make up what Greeno called a personal epistemology, which I define as one's fundamental beliefs about learning, evidence and authority, dispositions toward thinking, and assumptions about the limits and certainty of knowledge itself.

Based on work by Perry (1970) and using an instrument called the Reflective Judgment Interview (Kitchener & King, 1985), King and Kitchener (1990) identified a typical progression of operations that develop during post-adolescence. Freshmen typically enter college with a dualistic conception of reality in which all problems are well-structured and authorities are responsible for dispensing truth. These students often evolve through stages of uncertainty where multiple opinions are accepted as equally justified. They may eventually adopt a more mature belief that problems are indeed ill-structured and that truth is the product of interpretation within a particular perspective. The reflective judgment model is based on constructivist theory, since in the final stage, "knowledge is constructed by using skills of critical inquiry or by synthesizing evidence and opinion into cohesive and coherent explanations for beliefs about problems" (King & Kitchener, 1994, pg. 70).

Other theorists argue that personal epistemology, though general with regard to domains of knowledge, cannot be captured by a description of global developmental stages. For example,

it is widely accepted that children differ in their specific conceptions of intelligence, and that these conceptions influence whether learning or performance goals are adopted when approaching academic tasks (Dweck & Leggett, 1988). Regarding college students, Schommer (1990) has used results from an Epistemological Questionnaire (1989) to argue that epistemic beliefs exist as independent cognitive dimensions, each existing along a continuum anchored by extremes of intellectual maturity. Dimensions include: (1) *ability and effort* -- ability is innate so that learning does not depend on effort or it is mutable so that effort matters; (2) *simple knowledge* -- knowledge is discrete, unambiguous, and handed down by authority or it can be complex, ambiguous, and discovered using one's own thinking; (3) *certain knowledge* -- knowledge is certain and authorities should not be criticized or it is uncertain and authorities are subject to criticism; (4) *quick learning* -- learning occurs quickly (or not at all) or it requires time, deliberation, and reflection.

Whereas stages of development are often considered ends in themselves, so that measures such as the Reflective Judgment Interview capture a general critical thinking style (King, Wood, & Mines, 1990), other studies have shown that some epistemic dimensions are better predictors than others of students' ability to integrate information (Schommer, 1990), avoid oversimplified conclusions (Schommer et al., 1992), and write essays that acknowledge the complexity of a problem (Scheurman, 1993a). Although theoretical conceptions of personal epistemology vary, both views share the assumption that individuals possess networks of beliefs, or epistemic schemata, that continue to change beyond adolescence and that influence the way college students deal with complex, adult situations. In summary, researchers have concluded that students enter college as naive epistemologists and that professional growth in ill-structured domains depends on the development of a sophisticated set of assumptions about the uncertainty and complexity of knowledge. Teacher educators would be well served to put this knowledge of adult epistemic development to use as they make decisions about the personal and professional growth of pre-service teachers. This is why epistemic development occupies a prominent role in the social-developmental model of higher order thinking.

Sustained contextual support

In spite of gains in understanding about adult intellectual development, research associated with epistemic beliefs has been limited in one important way. Neither global stage theories nor conceptions of personal epistemology as independent cognitive dimensions explain how epistemic beliefs originate. In particular, there have been few studies aimed at the impact of specific efforts to induce changes in adults' conceptual orientation. Can personal epistemology be modified through instructional intervention? Although beliefs are generally thought to be tenacious, this does not mean they are always immutable. Research on related psychological

constructs reveals that intellectual abilities once thought to be stage-bound may not be as permanent as some people think (Bandura, 1986) and that relatively stable constructs such as intelligence (Goff & Ackerman 1992; Wagner & Sternberg, 1984), fluid abilities (Lohman, 1993), general problem-solving schemata (Torney-Purta, 1991), and even epistemological attitudes Gagne (1977) are subject to the laws of learning and are therefore malleable through training.

In light of this diverse evidence, a plausible hypothesis is that the type of thinking described by the Reflective Judgment Model is also modifiable and that certain socio-educational experiences are predictably better than others in promoting the intellectual maturity of young adults. Baron (1991) offered such a prediction, recommending that students who are given chances to observe and choose from among a range of reasoning prototypes are likely to alter certain naive beliefs underlying their patterns of informal reasoning. With regard to specific training of epistemic processes, studies involving medical students have shown that cognitive flexibility and the transfer of problem solving skills is enhanced when students are confronted with multiple, diverse cases in a domain (Spiro et al. 1987). Perkins and colleagues (1991) discovered that high school students often develop impoverished mental models of "everyday" social and political problems, as indicated by the level of bias and incompleteness with which they consider multiple perspectives. This results in a "makes-sense epistemology" (pg. 98ff) where students accept arguments as soon as they pass a minimum criterion for meaningfulness. After training in how to model a complex issue in an even-handed way, however, many students adopt a more "critical epistemology" as indicated by the number of "my-side" and "other-side" arguments generated in their responses to open-ended dilemmas.

Although this research does not disconfirm the existence of global developmental factors that influence college students' reasoning, it does suggest that young adults possess a range of abilities and dispositions with which to approach ill-structured problems. Furthermore, it implies that experiences in school are important in shaping epistemic beliefs and problem solving dispositions, so that with training, people can "learn to scaffold themselves to reason more fully" (Perkins et al., pg. 97). After years of theorizing about epistemological beliefs, the construction of knowledge, and the development of higher order thinking, experts in educational psychology have begun to translate theory into practice. Schommer (1990, pg. 504) concluded one research report by saying: "Both high school and college students may benefit from activities that raise their consciousness about the underpinnings of knowledge and learning and how their own epistemological views influence their learning." After two decades of rigorous research devoted to the delineation of reflective judgment stages, King & Kitchener (1994) have begun to describe the kind of activities they believe promote higher order thinking in college. Others have devoted entire texts to pedagogical recommendations for constructivist teaching (Brooks & Brooks,

1993) and the development of mature dispositions in critical thinking (Tishman, Perkins, & Jay, 1995). Finally, researchers in specific domains have also begun to translate research into practical suggestions. For example, Hammer (1994) suggests ways for physics teachers to offer "epistemological scaffolding" to students, to become alert to counter-productive epistemologies in instructional materials, and to choose epistemic beliefs as instructional objectives.

In summary, it seems clear that the role of sustained contextual efforts to foster intellectual maturity is another important variable in the quest for a comprehensive model to explain the nature of reasoning among pre-service teachers. Unfortunately, while research has revealed a great deal about the nature of adult conceptual orientation, recommended methods for promoting conceptual change have been studied much less.

Immediate contextual support

The final component in the model has to do with proximate conditions under which an individual is asked to exhibit higher order thinking. Vygotsky (1978) proposed the idea that individuals perform within a range of developmental levels depending on the nature of support provided on a given task. Researchers have since coined the term *situated cognition*, claiming that "thinking, knowing, and learning, can be considered as a relation involving an agent in a situation, rather than as an activity in an individual's mind" (Greeno 1989, pg. 135, see also Brown, Collins, & Duguid, 1989) and *scaffolding*, referring to the nature and level of assistance provided in a problem solving situation (see Palincsar & Brown, 1984). I have already discussed how adult reasoning is situated in the context of a problem's structure, in the epistemic beliefs held by individuals, and in the nature of experience one has had dealing with problems that require mature epistemic responses. Claims about situated cognition must also take into account the level of scaffolding provided in any assessment situation.

The general effects of scaffolding have been tested by Fischer (1980), who identified two distinguishable levels of performance on various skills: functional level is the quality of performance an individual can exhibit in situations that provide minimal environmental support; optimal level describes the most complex type of skill a person can control and is therefore assessed when some aspect of the environment provides support for the student. The fundamental claim of Fischer's skill theory is that an individual's level of competence is inevitably affected by the context in which an assessment is made (Fischer & Kenny, 1986).

As a result of Fischer's work, it is plausible to think of tasks as existing along a continuum in terms of the contextual support they provide. For example, Rest (1973) found that college students could comprehend prototypic expressions of moral reasoning at stages higher than they would produce spontaneously. Furthermore, students would often say they preferred reasoning at higher stages than they were able to comprehend. One argument for such a finding

is that while the *content* of moral dilemmas may be inherently uncertain, the *form* of each reasoning task may also differ in terms of structure. Thus, a recognition task is less ill-structured and therefore less cognitively demanding than a production task. This frees resources that can be devoted to higher-level activities such as evaluation of reasoning principles. In Fischer's terms, a production task constitutes a measure of functional performance, whereas a recognition task provides more scaffolding and is therefore likely to capture one's optimal performance. By extending the argument, a comprehension or explanation task would fall between recognition and production on the continuum of contextual support.

This notion of a hypothetical continuum of support is especially useful in examining the reasoning abilities of young adults. In one recent study, Kitchener and colleagues (1993) found that the level of reflective judgment exhibited by college students increased when they were asked to recognize and comprehend prototypic approaches to reasoning at various stages instead of being asked to generate a response independent of such prompts on the open-ended Reflective Judgment Interview. Two authors of the original study (Kitchener & Fischer, 1990, pg. 58) interpreted this finding in the following way:

... students typically operate at one developmental level when they act spontaneously (without contextual support) and at a higher developmental level when they experience contextual support and practice. In other words, reflective judgment performance can best be characterized by a developmental range.

It should be noted that in this study, immediate contextual support was not the only variable affecting adult reasoning performance. Reflective judgment also increased as a function of "practice," operationally defined as exposure to prototypic responses to ill-structured problems. The study was therefore important because it revealed how claims about reasoning ability are dependent on both types of contextual support: (1) support that involves interaction over time with comparative products of reasoning (sustained contextual support); and (2) support that involves the nature of assessment tasks from which such claims are derived (immediate contextual support).

College educators are beginning to recognize the need for constructing measures that are sensitive to the levels of scaffolding they provide as well as for capturing the kind of epistemic thinking that is unique to adults (Lohman & Scheurman, 1992). For example, McDaniel (1991) argued that critical thinking tests are typically well-structured and do not require people to construct or interpret situations in which problems are posed. Although more reliable and easy to administer than ill-defined tasks requiring student-generated responses, these tests do not provide information about cognitive complexity, a fundamental aspect of adult intellectual maturity. In other words, they represent a test of maximum (or optimal) rather than a test of typical (or functional) performance. McDaniel and Lawrence (1990) describe a scheme for evaluating

student essays that is designed to assess typical performance of students when responding to open-ended, ill-structured problems. Similar to stages in the reflective judgment model, lower levels of cognitive complexity are marked by unilateral descriptions and simplistic, certain answers to ill-structured problems, whereas higher level responses are marked by broad interpretations of ideas and integrated analyses.

In summary, higher order thinking among adults is intimately related to levels of epistemic development as well as to environmental variables such as the kind and amount of practice one has had dealing with ill-structured problems. However, before decisions can be made about the thinking competencies of teacher education students, it is also imperative that the nature of the immediate task situation from which inferences are drawn be scrutinized closely. This is why immediate contextual support represents the final variable in the social-developmental model. Together, these three broad factors interact in dynamic, context-dependent ways to determine the manner in which young adults will reason in ill-structured situations.

Research generated by the model

To show how the social-developmental model can provide a useful tool for designing research, I will share highlights from a series of empirical studies involving students and faculty in teacher education programs at two midwestern universities. (The details of these studies are reported elsewhere -- Scheurman, 1993a; 1993b). As I conduct this action research in the context of my own classes, I also find the model useful for facilitating dialogue about instructional and curricular decisions; however, the focus here is on research conducted within the framework of Figure 1.

One comprehensive study involved elementary and secondary education majors in a semester long Educational Psychology course. Students' *epistemic development* was assessed at the beginning and end of the semester using Schommer's Epistemological Questionnaire (1989). *Sustained contextual support* was manipulated by randomly assigning students to one of two discussion groups (approximately 30 in each group). Members of an "epistemic discussion group" participated in discussion activities designed to promote epistemological awareness through practice with ill-structured problems and exposure to reasoning prototypes. For example, students employed criteria associated with the Reflective Judgment Model and the Cognitive Complexity Scheme to evaluate written responses to complex problems both within and outside the domain of educational psychology. Students in a "content discussion group" spent the same amount of time having in-depth discussions of topics related to the course content without explicit attention to the nature of ill-structured problems or to exemplary approaches to thinking. Reasoning performance was assessed at the end of the course. A "comparison group"

was included in the final assessment. This group was comprised of students from other sections of the course. These classes were characterized by lectures and tests with no discussion groups.²

The final component of the model -- *immediate contextual support* -- was manipulated by designing a series of performance measures that differed in terms of the amount of scaffolding they provided students. On a highly supportive *recognition task*, students were asked to sort fifteen statements into five piles from "least to most reasonable approach to thinking." The statements were based on reflective judgment criteria (a fact that was hidden from students) and represented generic epistemological approaches to solving an ill-structured problem in education (phonetic vs. whole language reading instruction).³ Students also completed an *explanation task*, wherein students articulated criteria they used to place statements into piles (i.e. they "explained" their reasoning for why some approaches to thinking were better than others). Finally, students engaged in two *production tasks*. On a critical reading task, students read four brief arguments in response to open-ended dilemmas (e.g. whether to use criterion or norm-reference tests) and then described why each argument was weak or strong. These descriptions were scored using a holistic scheme for rating critical thinking (similar to Facione & Facione, 1994). The second production task was presented as a sole essay question on the final exam of students in the epistemic and content discussion groups (the essay was a position statement on the use of extrinsic rewards). These essays were evaluated using McDaniel's Cognitive Complexity Scheme.

In general, results of the study revealed the interdependence of factors comprising the social-developmental model. Since the epistemic and content discussion groups showed no significant differences on regular content exams during the course, analyses focused exclusively on higher order thinking. The first finding was a replication of previous research, namely that epistemic beliefs explained reasoning performance above and beyond other variables (e.g. GPA and ACT, see Table 1).⁴ The second finding involved the impact of sustained contextual support. Reasoning performance of students involved in epistemic discussion was significantly better on average than both the content discussion and comparison groups when it came to ranking prototypic statements and somewhat better when it came to explaining those rankings. In other words, students not only appeared to have internalized criteria associated with reflective judgment theory, they also used them in making judgments about others' approaches to thinking. However, as predicted by the model, the influence of epistemic discussion decreased as the level of scaffolding on each task decreased (see Table 1). Differences in performance between epistemic discussion and comparison groups (combined) were large (effect size = 1.24) for the highly supportive recognition task, whereas differences became less pronounced as tasks became less supportive (effect size=.61 for explanation task and .18 for essay production task).

[Insert Table 1 about here]

Another significant category of findings involved interactions between initial epistemic beliefs and the presence or absence of sustained contextual support (see Figure 2). On one hand, efforts to enhance epistemic awareness moderated weaker performance on a recognition task for students who initially held the naive belief that knowledge is certain (Figure 2A). On the other hand, students with an initial tolerance for ambiguity and a proclivity toward integration (a mature score on the simple knowledge scale) benefited more from epistemic discussion when it came to a critical reading production task (Figure 2B). This implies that naive individuals may "learn" to give a mature response in a contextually supportive situation, whereas the transfer of that learning to less supportive situations may depend on having internalized aspects of a mature personal epistemology prior to the instructional intervention. Finally, prior academic achievement (GPA) was the best predictor of performance on the ill-structured essay task. However, this was also moderated by epistemic training, the presence of which raised cognitive complexity scores of lower-achieving students (Figure 2C).

[Insert Figure 2 about here]

To test the importance of scaffolding in a problem solving situation relative to the level of sustained contextual support one receives, a second study was designed in which only the level of *immediate contextual support* was manipulated. In this experiment, fifty undergraduate education students in a foundations course were randomly assigned to one of two groups on the first day of class. Students in both groups received NO training; they were merely administered one of two versions of the prototypic recognition and explanation tasks described earlier. As in the first study, students in a "non-support" group sorted the fifteen prototypic statements into five piles and then explained why some piles represented more reasonable approaches to thinking than others. However, students in a "support group" were first told which piles to place the fifteen statements in and then asked to explain the rankings. Results showed that members of the support group were able to articulate an average of nearly five criteria associated with the reflective judgment model, whereas members of the non-support group were able to articulate just over two epistemic criteria ($t=4.68$; $p<.001$). In addition, seventeen students in the support group were able to identify at least one criterion from one of the two most sophisticated piles of pre-sorted statements, whereas only three students were able to do so after sorting the statements themselves. The results of this study suggest that enhancements in reflective judgment brought about by a semester long intervention (study #1) were essentially replicated in a single testing session when the conditions of immediate contextual support were strengthened considerably (study #2). This finding has profound implications for the way college educators assess their

students. It appears that the young adults in these studies possessed a sophisticated, though latent, set of conceptions about thinking and knowledge. Furthermore, it appears that a sufficient level of scaffolding on an assessment task is capable of impacting student approaches to ill-structured problems regardless of the absence or presence of sustained efforts to enhance epistemic awareness.

Discussion

Overall, the results of this research suggest that developmental, social, and contextual variables function as interdependent factors that affect adult reasoning. Three conclusions were warranted from the research. First, to say that personal epistemologies influence the way students will approach ill-structured problems is a claim that can no longer be overlooked. Furthermore, the evidence suggests that different dimensions of belief predispose students to benefit from epistemic discussion in different ways. This implies that teachers should make efforts to find out what entering students believe about the certainty of knowledge, role of authority, mutability of intelligence, and so on. Second, the study suggests the viability of instructional intervention as a means to promote epistemic awareness and reflective reasoning habits among college students. This claim is derived from the fact that students who explored various epistemological approaches to ill-structured problems were able to employ criteria associated with the Reflective Judgment Model in making judgments about the reasoning approaches of others. Unfortunately, the pattern of declining improvements as post-intervention tasks provided less scaffolding suggests that enhanced abilities or changed dispositions resulting from epistemic discussion may not transfer to authentic situations. The third major finding, then, concerns the importance of immediate assessment conditions in making judgments about the thinking abilities of college students. Although determining the causes of conceptual change among adults remains an inexact science, it is clear that epistemological approaches to problem solving do change when conditions of contextual support change. Furthermore, performance on ill-structured problem solving tasks seems to be affected as much by the level of scaffolding one receives in the immediate problem solving situation as it is by sustained efforts to promote epistemic awareness.

In summary, then, this program of research has served to confirm the social-developmental model as a useful vehicle for thinking about the manner in which teacher educators promote and assess reasoning among college students. Although the model can be used by pre-service teachers whose interest is factors that influence higher order thinking in children, the main focus of this paper has been on how it can be used by university faculty, whose interest is factors that influence higher order thinking among pre-service teachers when confronted with ill-structured problems. Therefore, I will conclude by discussing how the model

and research associated with it has led me to consider several specific implications for teacher education.

Implications for teacher education

Greeno (1989, pg. 136) argued that "it is untenable ... to simply ask whether someone knows a fact or understands a principle, because that knowledge or understanding is in a context of the person's beliefs and understandings about what knowledge and understanding are." An increasing interest in personal epistemology as an integral component of higher order thinking is having an impact on the manner in which pre-service teachers are being educated in this country. Research at Berkeley suggests that college students evolve from behaviorist conceptions of pedagogy (e.g. the goal of instruction is to transmit facts and procedures by showing and telling) to constructivist conceptions that are at first global (e.g. the goal of instruction is to improve conceptual understanding by engaging students in provocative activities) but eventually become more differentiated and integrated (e.g. the goal of instruction is to help students develop reflective ways of thinking that can lead to better understanding).

By reporting these evolutionary ways of thinking about pedagogy, the authors imply that the teacher education curriculum was instrumental in effecting changes in student beliefs. However, the specific causes and consequences of such changes remains unclear. The social-developmental model creates a vehicle for raising and discussing questions about the epistemologies operating in classrooms at various levels. How resistant to modification are particular epistemic beliefs? What instructional interventions are most likely to encourage conceptual change and at what age? Answers to these questions are critical if the goal of helping students acquire a "contemporary psychological perspective" is to become a reality. The model also raises questions about how to determine whether conceptual change has occurred. This is critical since the manner in which we assess students' personal epistemology can have a dramatic effect on the inferences we make about their capabilities, and, consequently, about the instructional decisions we make as their teachers. I recently completed a pilot study of general education faculty and discovered that they have a tendency to underestimate undergraduates' level of sophistication when it comes to reflective judgment and critical thinking dispositions (see also Dings, 1989). These findings raise questions about how college faculty "arrive at assumptions and expectations about students' reasoning skills, how they translate these ... into assignments and grading criteria, how students understand these expectations, and whether and how discrepancies between educators' assumptions and students' skills are addressed" (King & Kitchener, 1994, pg. 169).

Regarding teacher education, the *developmental* aspect of the model is important because it deals with the nature of adult intellectual maturity. It is one thing to have pre-service education

students study abstract theories concerning the cognitive maturity of their future charges and then ask them how this knowledge will influence the kinds of instruction they are likely to design. It is another thing altogether for university faculty to consider the level of conceptual maturity of their own students and then design instruction on the basis of that knowledge. Teaching at all levels is a multidimensional, ill-structured activity characterized by a high degree of uncertainty. Furthermore, dealing with ill-structured problems requires a sophisticated view of learning and knowledge itself. Like the kids that pre-service teachers will one day entertain, college students enter teacher preparation programs with epistemological orientations that affect what and how they learn. Some of these epistemologies contain naive beliefs or misconceptions, leading Anderson et al. (in press, pp. 26-27) to conclude that "assisting prospective teachers in their epistemological development is unavoidably part of the job" of a teacher educator. In short, while it is important for education majors to anticipate the developmental variations they are likely to encounter as teachers, it is equally important for university teachers to anticipate the developmental variations of college students. Not to do so would violate the very psychological perspective they are trying to inculcate.

The *social* aspect of the model is important because it deals with the nature of adult learning. Unfortunately, every teacher education program cannot be expected to attract students "willing to suspend their desire to learn the 'right way' to teach as quickly as possible while investing the time necessary ... to construct ... ways to put complex theory and research to work in their classrooms" (Black & Ammon, pp. 323-324). In teacher education courses, teachers typically spend lots of time exploring techniques to help children learn. But how often do teacher educators consider developmental limits they face in guiding their students toward reflective ways of dealing with complex problems associated with teaching? Given the growing recognition and importance of epistemological beliefs (especially how naive beliefs and misconceptions pose barriers to adult learning), some educational psychologists have argued that one instructional goal of teacher education ought to be conceptual change in the broadest possible meaning of the phrase (Sykes & Byrd, 1992).

If the objective of teacher education is to equip teachers with a contemporary psychological perspective of teaching and learning, and if that perspective involves the nuances of constructivism and higher order thinking, then teacher educators need models for coping with the complex issues inherent in teaching. The very tenets of constructivism beckon us to consider the contextual nature of knowledge and reasoning. To propose a model that merely breaks the world down into isolated variables would be to violate the complex and dynamic nature of knowledge construction (e.g. see Wheatley, 1994). The social-developmental model of higher order thinking represents a vehicle to "frame and simplify (*without oversimplifying*) the complexities of teaching" (Anderson et al., in press, *italics added*). The model is under perpetual

revision. For example, one limitation is that it ignores an entire set of motivational variables within which higher order thinking is obviously situated. Nevertheless, I have found that the model satisfies criteria set for it: (a) it is consistent with a constructivist psychological perspective; (b) it incorporates what we know about adult reasoning, especially ill-structured problem solving and personal epistemology; and (c) it serves as a vehicle for college faculty to design research, instruction, and assessment. In summary, the social-developmental model is a tool that has helped me exercise the Socratic imperative: to know myself and to know my students.

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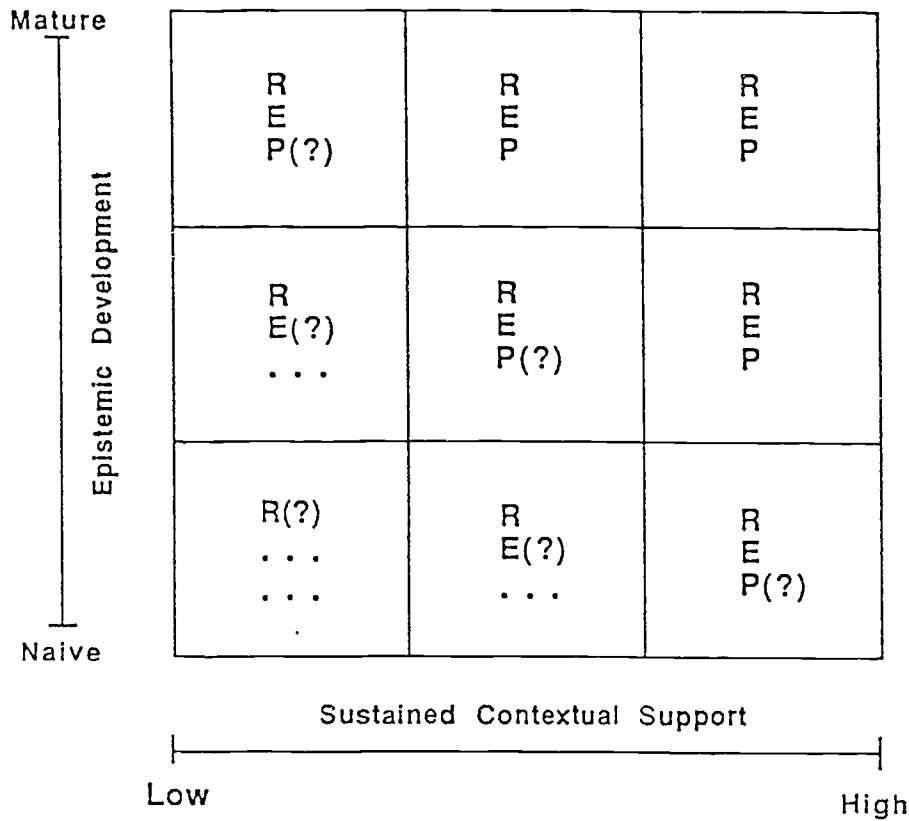
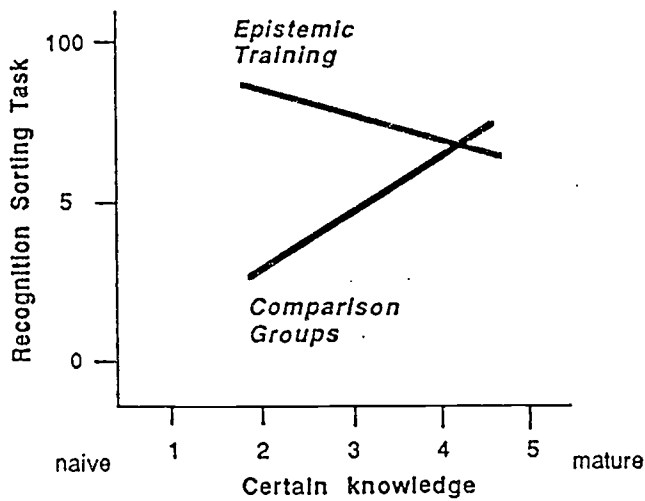
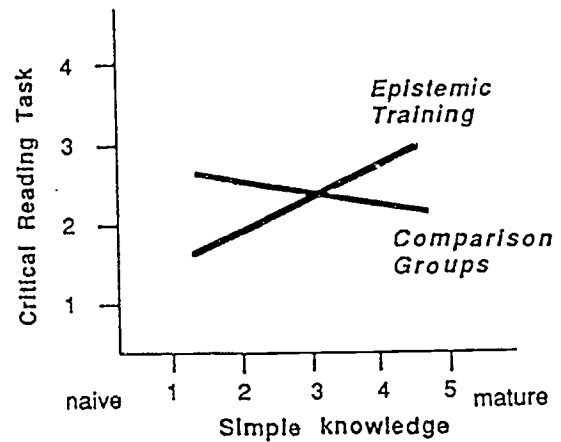


Figure 1. Social-developmental model of adult reasoning.

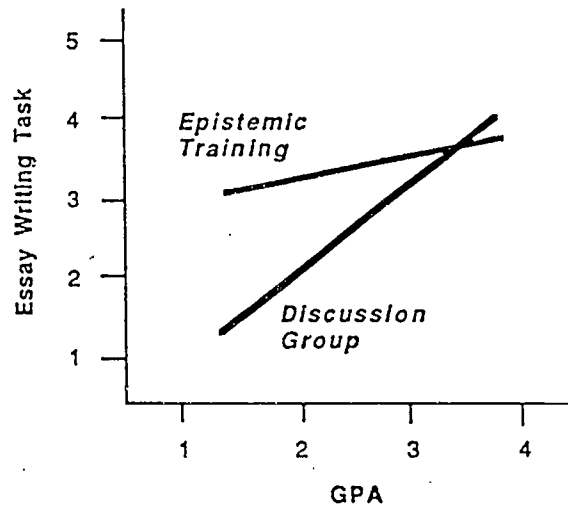
Note. **Epistemic development**, shown on the vertical axis, refers to the sophistication of one's general epistemological beliefs or to the specific level of conceptual development one possesses within a domain. **Sustained contextual support**, shown on the horizontal axis, is represented by three columns corresponding to theoretical levels of practice and guided instruction within a particular epistemological framework. **Immediate contextual support**, represented by letters in the matrix, refers to the level of scaffolding provided by an assessment task. A capital letter implies that one's level of epistemic development and/or sustained contextual support is sufficient for an effective response to occur within a response mode. In ascending order of support, response modes include: **R** = *recognition task*; **E** = *explanation task*; **P** = *production task*. Other symbols have the following meaning: (?) = effective response is unpredictable within a particular response mode; ... = effective response is unexpected due to insufficient development and/or experience.



2A: Group X Beliefs in Certainty on Recognition Sorting Task



2B: Group X Beliefs in Simplicity on Critical Thinking Production Task



2C: Group X GPA on Essay Production Task

Figure 2. Regression lines showing interactions between experimental groups and select variables across a range of tasks:

(2A) Interaction between beliefs about certain knowledge and experimental group on a Prototypic Recognition Sorting Task; (2B) Interaction between beliefs about simple knowledge and experimental group on a Critical Reading Production Task; (2C) Interaction between prior achievement (GPA) and experimental group on an Essay Writing Production Task.

Table 1

Relative contributions made by blocks of variables on dependent measures.

	Recognition Task	Explanation Task	Production Tasks	
			Critical Reading	Final Essay
Achievement (ACT/GPA) ^a	.22***	.19***	.08*	.22**
Age	.04*	.02	.00	.02
Epistemic beliefs ^b	.04*	.05*	.09*	.07*
Training ^c	.19***	.06**	.04*	.03
Interactions ^d	.02	.02	.08	.13
TOTAL R ²	.51***	.34***	.30*	.48**

Note. Numbers represent R² increments at the point each block was entered in the model; *** p < .01; ** p < .05; * p < .10.

^a Scores from the English portion of the ACT were used. ACT was a far more salient variable than GPA, accounting for the largest portion of variance in the block.

^b The particular epistemic dimension varied across tasks: recognition = Simple Knowledge; explanation = Ability and Effort; critical reading = Certain Knowledge and Simple Knowledge (relatively equal contributions); essay = Quick Learning.

^c The variable created for this block (G1) involved a comparison between the epistemic discussion group and the other two groups combined.

^d Specific interactions were analyzed using reduced regression models. Confidence levels ranging from p < .05 to p < .15 are reported elsewhere (Scheurman, 1993a).

Notes

¹ The basic structure and function of the model in Figure 1 is analogous to a social-developmental model proposed by Kassin and Lepper (1984) to describe the motivational phenomenon of discounting in young children. According to their model, children's use and understanding of the discounting principle is a joint function of cognitive development (operationalized as age), specific social learning history (operationalized as the frequency with which a child is exposed to concrete instances of an inverse relation between external pressure and internal motives), and response mode (operationalized in terms of various manners of expression).

In a preliminary test of the model (Kassin & Ellis, 1988), children were observed to exhibit discounting *behavior* before they were able to make schema-consistent *judgments* about others' behavior. In turn, the ability to make such judgments preceded the ability to *explain* the formal rule of discounting. However, this pattern was influenced by the degree to which children were exposed to analogous situations. Apparently, younger students were able to formulate (i.e. "learn") a social script that compensated for a lack of relevant experiences which would have occurred naturally as a function of age (development). Kassin & Lepper's model figured prominently in the logic behind the social-developmental model described here.

² it should be noted that the purpose of the study was to test the role of sustained contextual support in general, NOT to test a particular training program. Therefore, certain concessions had to be made. For example, a confounding of instructor and methods was necessary to preserve the authenticity of the situation. It was understood in advance that this would make it difficult to identify specific causes of differences in reasoning performance among groups. Given the main purpose of the study, however, these experimental limitations did not destroy the integrity of the study. As Palincsar and Brown (1984) argued, in locating ways to improve cognitive functioning, it is often important to obtain a sizable effect first and then conduct research to determine the precise components responsible for success. Furthermore, in moving from correlational to causal claims about the role of certain factors, training studies occupy a place in a larger constellation of converging evidence. This was one such study.

³ This recognition task was patterned after the Prototypic Reflective Judgment Interview, used by Kitchener et al. (1993; see also Lynch, 1989) to demonstrate the impact of contextual support on reflective judgment performance (discussed earlier). The Prototypic Recognition Sorting Task is available from the author.

⁴ It is interesting to note that various dimensions of belief contributed differentially depending on the task. For example, beliefs about simple knowledge and dependence on authority explained recognition performance; beliefs about ability and effort accounted for variance in explanation performance; beliefs about simple knowledge and certain knowledge explained critical reading performance; and beliefs about quick learning explained essay writing performance. These results corroborated the view that independent cognitive dimensions of epistemic belief are identifiable within the more global category of personal epistemology. Implications of specific dimensions and specific tasks are discussed elsewhere (Scheurman, 1993a).